CLAIMS

1. A chemical vapor deposition method comprising:

positioning a semiconductor substrate within a chemical vapor deposition chamber;

feeding a first deposition precursor to a remote plasma generation chamber positioned upstream of the deposition chamber and generating a plasma therefrom within the remote chamber and effective to form a first active deposition precursor species, and flowing the first species to the deposition chamber;

during the flowing, diverting flow of at least some of the first species from entering the deposition chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber; and

ceasing said diverting while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber.

2. The method of claim 1 wherein the chemical vapor deposition comprises atomic layer deposition.

3. The method of claim 1 wherein the diverting comprises diverting substantially all flow of the first species from entering the deposition chamber.

4. The method of claim 1 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet, and wherein the diverting comprises flow into a second passageway inlet, and further comprising maintaining pressure of the first inlet and the second inlet within 500 mTorr from one another during the flowing and the diverting.

5. The method of claim 1 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet and wherein the diverting comprises flow into a second passageway inlet, and further comprising maintaining pressure of the first inlet and the second inlet within 100 mTorr from one another during the flowing and the diverting.

6. The method of claim 1 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet, and wherein the diverting comprises flow into a second passageway inlet, and further comprising keeping pressure of the first inlet and the second inlet greater than 500 mTorr from one another during the flowing and the diverting.

7. The method of claim 1 wherein the diverting comprises diverting substantially all flow of the first species from entering the deposition chamber, and wherein the diverting takes from 0.1 to 1.0 second from starting the diverting of the first species to total diversion of the first species.

8. The method of claim 1 wherein the diverting comprises diverting substantially all flow of the first species from entering the deposition chamber, and wherein the diverting takes more than 1.0 second from starting the diverting of the first species to total diversion of the first species.

9. The method of claim 1 wherein said diverting and ceasing thereof is controlled by a single valve assembly located downstream of the remote chamber and upstream of the deposition chamber as respects flow of the first deposition precursor.

10. The method of claim 1 wherein said diverting comprises rotating a cylindrical valve mass.

11. The method of claim 1 wherein said diverting comprises rotating a valve plate.

12. The method of claim 1 wherein said diverting comprises rotating a round valve plate.

13. The method of claim 1 wherein said diverting comprises rotating a valve plate about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate.

14. The method of claim 1 wherein said ceasing comprises rotating a valve plate about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate.

15. The method of claim 1 wherein said diverting comprises rotating a valve plate in a first rotational direction about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate, and wherein said ceasing comprises another rotating of the valve plate in the first rotational direction about said rotation axis.

16. The method of claim 1 wherein said diverting comprises pivoting a flap.

17. The method of claim 1 wherein said diverting comprises straight linearly sliding a diverting valve mass.

18. An atomic layer deposition method comprising:

positioning a semiconductor substrate within an atomic layer deposition chamber;

feeding a first deposition precursor to a remote plasma generation chamber positioned upstream of the deposition chamber and generating a plasma therefrom within the remote chamber and effective to form a first active deposition precursor species, and flowing the first species to the substrate effective to form a first monolayer on the substrate;

during the flowing, diverting flow of substantially all the first species from entering the deposition chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber;

while diverting, flowing a purge gas to the chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber; and

after flowing the purge gas, ceasing said diverting while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber effective to form another monolayer on the substrate.

19. The method of claim 18 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet, and wherein the diverting comprises flow into a second passageway inlet, and further comprising maintaining pressure of the first inlet and the second inlet within 500 mTorr from one another during the flowing and the diverting.

20. The method of claim 18 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet and wherein the diverting comprises flow into a second passageway inlet, and further comprising maintaining pressure of the first inlet and the second inlet within 100 mTorr from one another during the flowing and the diverting.

21. The method of claim 18 wherein the flowing of the first species is at subatmospheric pressure and comprises flow into a first passageway inlet, and wherein the diverting comprises flow into a second passageway inlet, and further comprising keeping pressure of the first inlet and the second inlet greater than 500 mTorr from one another during the flowing and the diverting.

22. The method of claim 18 wherein the diverting takes from 0.1 to 1.0 second from starting the diverting of the first species to total diversion of the first species.

23. The method of claim 18 wherein the diverting takes more than 1.0 seconds from starting the diverting of the first species to total diversion of the first species.

24. The method of claim 18 wherein said diverting and ceasing thereof is controlled by a single valve assembly located downstream of the remote chamber and upstream of the deposition chamber as respects flow of the first deposition precursor.

25. The method of claim 18 wherein said diverting comprises rotating a cylindrical valve mass.

26. The method of claim 18 wherein said diverting comprises rotating a valve plate.

27. The method of claim 18 wherein said diverting comprises rotating a round valve plate.

28. The method of claim 18 wherein said diverting comprises rotating a valve plate about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate.

29. The method of claim 18 wherein said ceasing comprises rotating a valve plate about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate.

30. The method of claim 18 wherein said diverting comprises rotating a valve plate in a first rotational direction about a rotation axis oriented generally parallel with respect to a direction of first species flow proximate the valve plate, and wherein said ceasing comprises another rotating of the valve plate in the first rotational direction about said rotation axis.

31. The method of claim 18 wherein said diverting comprises pivoting a flap.

32. The method of claim 18 wherein said diverting comprises straight linearly sliding a diverting valve mass.

33. An atomic layer deposition method comprising:

positioning a semiconductor substrate within an atomic layer deposition chamber;

feeding a first deposition precursor to a remote plasma generation chamber positioned upstream of the deposition chamber and generating a plasma therefrom within the remote chamber and effective to form a first active deposition precursor species, and flowing the first species to the substrate effective to form a first monolayer on the substrate;

during the flowing, diverting flow of substantially all the first species from entering the deposition chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber;

while diverting, flowing a purge gas to the chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber;

after flowing the purge gas and while diverting, feeding a second deposition precursor different from the first deposition precursor to the deposition chamber effective to form a second monolayer on the first monolayer and while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber;

after forming the second monolayer and while diverting, flowing a purge gas to the chamber while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber; and

after flowing purge gas after forming the second monolayer, ceasing said diverting while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber effective to form a third monolayer on the second monolayer.

34. A chemical vapor deposition method comprising:

positioning a semiconductor substrate within a chemical vapor deposition chamber;

feeding a first deposition precursor to the chamber through at least a portion of a rotatable cylindrical mass of a valve assembly;

during the flowing, diverting flow of at least some of the first deposition precursor from entering the deposition chamber by rotating the cylindrical mass in a first rotational direction; and

during the diverting, rotating the cylindrical mass in the first rotational direction effective to cease said diverting.

35. The method of claim 34 wherein the chemical vapor deposition comprises atomic layer deposition.

36. The method of claim 34 comprising maintaining rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting.

37. The method of claim 36 wherein the maintaining is at a variable rate of rotation in the first rotational direction among the feeding to the diverting to the ceasing of said diverting.

38. The method of claim 34 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting.

39. The method of claim 34 comprising maintaining rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting, and continuing said rotation in the first rotational direction after said ceasing effective to start said feeding again.

40. The method of claim 34 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting, and continuing said rotation at the constant rate in the first rotational direction after said ceasing effective to start said feeding again.

41. A chemical vapor deposition method comprising:

positioning a semiconductor substrate within a chemical vapor deposition chamber;

feeding a first deposition precursor to a remote plasma generation chamber positioned upstream of the deposition chamber and generating a plasma therefrom within the remote chamber and effective to form a first active deposition precursor species, and flowing the first species to the deposition chamber through at least a portion of a rotatable cylindrical mass of a valve assembly;

during the flowing, diverting flow of at least some of the first species from entering the deposition chamber by rotating the cylindrical mass in a first rotational direction while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber; and

during the diverting, rotating the cylindrical mass in the first rotational direction effective to cease said diverting while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber.

42. The method of claim 41 comprising maintaining rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting.

43. The method of claim 42 wherein the maintaining is at a variable rate of rotation in the first rotational direction among the feeding to the diverting to the ceasing of said diverting.

44. The method of claim 41 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting.

45. The method of claim 41 comprising maintaining rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting, and continuing said rotation in the first rotational direction after said ceasing effective to start said feeding again.

46. The method of claim 41 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass in the first rotational direction from the feeding to the diverting to the ceasing of said diverting, and continuing said rotation in the first rotational direction at the constant rate after said ceasing effective to start said feeding again.

47. An atomic layer deposition method comprising:

positioning a semiconductor substrate within an atomic layer deposition chamber;

feeding a first deposition precursor to a remote plasma generation chamber positioned upstream of the deposition chamber and generating a plasma therefrom within the remote chamber and effective to form a first active deposition precursor species, and flowing the first species to the substrate through at least a portion of a rotatable cylindrical mass of a valve assembly effective to form a first monolayer on the substrate;

during the flowing, diverting flow of substantially all the first species from entering the deposition chamber with the rotatable cylindrical mass while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber;

while diverting, flowing a purge gas to the chamber through at least a portion of the rotatable cylindrical mass of the valve assembly while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber; and

after flowing the purge gas, rotating the cylindrical mass effective to cease said diverting while feeding and maintaining plasma generation of the first deposition precursor within the remote chamber effective to form another monolayer on the substrate.

48. The method of claim 47 wherein the portion through the rotatable cylindrical mass of the valve assembly through which the first species flows is different from the portion through the rotatable cylindrical mass of the valve assembly through which the purge gas flows.

49. The method of claim 47 comprising maintaining rotation of the rotatable cylindrical mass from the feeding to the diverting to the purge gas flowing to the ceasing of said diverting.

50. The method of claim 49 wherein the maintaining is at a variable rate of rotation among the feeding to the diverting to the purge gas flowing to the ceasing of said diverting.

51. The method of claim 47 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass from the feeding to the diverting to the purge gas flowing to the ceasing of said diverting.

52. The method of claim 41 comprising maintaining rotation of the rotatable cylindrical mass from the feeding to the diverting to the purge gas flowing to the ceasing of said diverting, and continuing said rotation after said ceasing effective to start said feeding again.

53. The method of claim 41 comprising maintaining a constant rate of rotation of the rotatable cylindrical mass from the feeding to the diverting to the purge gas flowing to the ceasing of said diverting, and continuing said rotation at the constant rate after said ceasing effective to start said feeding again.

54. A semiconductor processing reactive precursor valve assembly comprising:

a valve body having at least one inlet and at least two outlets, the inlet being configured for connection with a reactive precursor source, a first of the outlets being configured for connection with a feed stream to a semiconductor substrate processor chamber, a second of the outlets being configured for diverting precursor flow away from said chamber;

the valve body comprising a first fluid passageway therein extending between the inlet and the first outlet, the valve body comprising a second fluid passageway extending between the first fluid passageway and the second outlet; and

a control plate mounted for at least limited rotation within the body proximate the first and second passageways, the plate including an arcuate region at least a portion of which is received within the first passageway, the arcuate region including a first region having an opening extending through the plate positionable into a first selected radial orientation to provide the inlet and the first outlet in fluid communication with one another through the first passageway while restricting flow to the second passageway, the arcuate region including a second region positionable into the first radial orientation to provide the inlet and second outlet in fluid communication through the first and second passageways while restricting flow to the first outlet.

55. The assembly of claim 54 wherein the first passageway extends in a straight axial line through the valve body from the inlet to the first outlet.

56. The assembly of claim 54 wherein the second passageway extends in a straight axial line through the valve body from the first passageway to the second outlet.

57. The assembly of claim 54 wherein,

the first passageway extends in a first straight axial line through the valve body from the inlet to the first outlet; and

the second passageway extends in a second straight axial line through the valve body from the first passageway to the second outlet.

58. The assembly of claim 57 wherein the first and second axial lines are perpendicular to one another.

59. The assembly of claim 54 wherein the control plate is circular.

60. The assembly of claim 54 wherein the control plate is mounted for 360° rotation within the body.

61. The assembly of claim 54 wherein the arcuate region is an annulus including a plurality of alternating of said first and second regions.

62. The assembly of claim 54 wherein,

the control plate is mounted for 360° rotation within the body; and

the arcuate region is an annulus including a plurality of alternating of said first and second regions.

63. The assembly of claim 62 comprising at least three of said first regions and at least three of said second regions.

64. The assembly of claim 54 wherein the first region is configured to block substantially all fluid flow to the second passageway when in the first selected radial orientation.

65. The assembly of claim 54 wherein the second region is configured to block substantially all fluid flow to the first outlet when in the second selected radial orientation.

66. The assembly of claim 54 wherein the first region plate opening has a maximum cross section which is at least as large as that of the first passageway proximate the control plate.

67. The assembly of claim 54 wherein the first region plate opening has a cross sectional shape which is the same as that of the first passageway proximate the control plate.

68. The assembly of claim 54 wherein the first region plate opening has a cross sectional shape which is different from that of the first passageway proximate the control plate.

69. The assembly of claim 54 wherein the first passageway extends in a straight axial line through the valve body from the inlet to the first outlet, the control plate being mounted for rotation about an axis which is generally parallel with the straight axial line.

70. The assembly of claim 54 wherein the second region does not include a hole extending through the plate.

71. The assembly of claim 54 wherein the second region comprises an arcuate surface configured to direct fluid flow 90° from a flow direction to the plate.

72. The assembly of claim 54 wherein the second region comprises:

an arcuate surface configured to direct fluid flow 90° from a flow direction to the plate; and

a flat surface connected with the arcuate surface which extends to the second passageway when in the first radial position.

73. A semiconductor processing reactive precursor valve assembly comprising:

a valve body having at least one inlet and at least two outlets, the inlet being configured for connection with a reactive precursor source, a first of the outlets being configured for connection with a feed stream to a semiconductor substrate processor chamber, a second of the outlets being configured for diverting precursor flow away from said chamber;

the valve body comprising a first fluid passageway therein extending between the inlet and the first outlet in a first straight axial line, the valve body comprising a second fluid passageway extending between the first fluid passageway and the second outlet in a second straight axial line which is perpendicular to the first straight axial line; and

a circular control plate mounted for at least limited rotation within the body proximate the first and second passageways about an axis of rotation which is generally parallel with the first straight axial line, the plate including an arcuate region at least a portion of which is received within the first passageway, the arcuate region including a first region having an opening extending through the plate positionable into a first selected radial orientation to provide the inlet and the first outlet in fluid communication with one another through the first passageway while blocking substantially all fluid flow to the second passageway, the first region plate opening having a maximum cross section which is at least as large as that of the first passageway proximate the control plate, the arcuate region including a second region

positionable into the first radial orientation to provide the inlet and the second outlet in fluid communication through the first and second passageway while blocking substantially all flow to the first outlet, the second region comprising an arcuate surface configured to direct fluid flow 90° from a flow direction to the plate, the second region comprising a flat surface connected with the arcuate surface which extends to the second passageway when in the first radial position.

74. The assembly of claim 73 wherein the control plate is mounted for 360° rotation within the body.

75. The assembly of claim 73 wherein the arcuate region is an annulus including a plurality of alternating of said first and second regions.

76. The assembly of claim 73 wherein,

the control plate is mounted for 360° rotation within the body; and

the arcuate region is an annulus including a plurality of alternating of said first and second regions.

77. The assembly of claim 76 comprising at least three of said first regions and at least three of said second regions.

78. A semiconductor processing reactive precursor valve assembly comprising:

a valve body having at least one inlet and at least two outlets, the inlet being configured for connection with a reactive precursor source, a first of the outlets being configured for connection with a feed stream to a semiconductor substrate processor chamber, a second of the outlets being configured for diverting precursor flow away from said chamber;

the valve body comprising a first fluid passageway therein extending between the inlet and the first outlet, the valve body comprising a second fluid passageway extending between the first fluid passageway and the second outlet; and

a generally cylindrical mass mounted for at least limited rotation within the body proximate the first and second passageways, the mass including an arcuate region at least a portion of which is received within the first passageway, the arcuate region including a first region having an opening extending through the mass positionable into a first selected radial orientation to provide the inlet and the first outlet in fluid communication with one another through the first passageway while restricting flow to the second passageway, the arcuate region including a second region positionable into the first radial orientation to provide the inlet and second outlet in fluid communication through the first and second passageways while restricting flow to the first outlet.

79. The assembly of claim 78 wherein the generally cylindrical mass is mounted for 360° rotation within the body.

80. A semiconductor processing reactive precursor valve assembly comprising:

a valve body having at least first and second inlets and at least two outlets, the first and second inlets being configured for connection with distinct gas sources at least one of which is a deposition precursor, a first of the outlets being configured for connection with a feed stream to a semiconductor substrate processor chamber, a second of the outlets being configured for diverting gas flow away from said chamber;

a generally cylindrical mass mounted for at least limited rotation within the body;

the generally cylindrical mass comprising a first longitudinal portion configured to provide the first inlet in fluid communication with the first outlet when in a first selected radial orientation and to provide the first inlet in fluid communication with the second outlet when in a second selected radial orientation; and

the generally cylindrical mass comprising a second longitudinal portion proximate the first longitudinal portion and which is configured to provide the second inlet in fluid communication with the first outlet when in the second selected radial orientation and to provide the second inlet in fluid communication with the second outlet when in the first selected radial orientation.

81. The assembly of claim 80 wherein the first and second longitudinal portions are substantial mirror images of one another.

82. The assembly of claim 80 wherein the generally cylindrical mass comprises two overlapping half cylindrical shaped sections.

83. The assembly of claim 80 wherein the first longitudinal portion is configured to provide the first inlet in fluid communication with both the first and second outlets when in a third selected radial orientation.

84. The assembly of claim 83 wherein the first longitudinal portion is configured to provide the first inlet in fluid communication with both the first and second outlets when in a fourth selected radial orientation which is 180° from the third selected radial orientation.

85. The assembly of claim 80 wherein the second longitudinal portion is configured to provide the second inlet in fluid communication with both the first and second outlets when in a third selected radial orientation.

86. The assembly of claim 85 wherein the second longitudinal portion is configured to provide the second inlet in fluid communication with both the first and second outlets when in a fourth selected radial orientation which is 180° from the third selected radial orientation.

87. The assembly of claim 80 wherein the first longitudinal portion is configured to provide the first inlet in fluid communication with both the first and second outlets when in a third selected radial orientation and the second longitudinal portion is configured to provide the second inlet in fluid communication with both the first and second outlets when in the third selected radial orientation.

88. The assembly of claim 87 wherein the first longitudinal portion is configured to provide the first inlet in fluid communication with both the first and second outlets when in a fourth selected radial orientation which is 180° from the third selected radial orientation and the second longitudinal portion is configured to provide the second inlet in fluid communication with both the first and second outlets when in the fourth selected radial orientation.

89. The assembly of claim 80 wherein the first and second inlets to the valve body are 180° opposed.

90. The assembly of claim 80 wherein the first and second outlets from the valve body are 180° opposed.

91. The assembly of claim 80 wherein,

the first and second inlets to the valve body are 180° opposed; and

the first and second outlets from the valve body are 180° opposed.

92. The assembly of claim 80 wherein at least one inlet to the valve body is oriented at 90° from at least one outlet from the body.

93. The assembly of claim 80 wherein,

the first and second inlets to the valve body are 180° opposed;

the first and second outlets from the valve body are 180° opposed; and

the first and second inlets to the valve body are oriented at 90° from the first and second outlets from the body.